

28. Deutsche Arbeitsbesprechung über Fragen der Unkrautbiologie und -bekämpfung, 27.02. – 01.03.2018 in Braunschweig

Effect of different soil cultivation methods on the emergence of *Apera spica-venti*

Einfluss der Bodenbearbeitung auf den Auflauf von Apera spica-venti

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DOI 10.5073/jka.2018.458.043



Abstract

Minimum tillage, i.e. without plowing the soil, is practiced on about 40% of the arable fields in Germany. The effects on the long run of this soil cultivation are investigated in a long-term field trial. Since autumn 2007 two different soil cultivation methods are investigated in a long-term field trial, among other things, for the emergence of *Apera spica-venti* before herbicide control. The experimental fields are located in Germany, in the federal state of Brandenburg, about 50 km from Berlin. The crop rotation consists of winter oilseed rape, winter wheat, winter rye, winter barley, winter triticale, peas and maize. The plots were treated with herbicide since the start of the field trial in 1995. Weeds were counted before herbicide application in autumn or spring. For each plot 4 points with an area of 0.25 m² were investigated and both weed number and species were determined.

The results show that the median of *Apera spica-venti* plants spans from 9 (year 2013) to 55 (2010) plants per m² in cereals crop plots with plowing. For the plots without plowing the median ranges between 18 (2009) and 140 (2017) *Apera spica-venti* plants per m². In plots without plowing the numbers of emerging *Apera spica-venti* plants has been rising since the year 2007.

Keywords: *Apera spica-venti*, long-term field trial, loose silky-bentgrass, tillage

Zusammenfassung

Auf ca. 40 % der Ackerfläche in Deutschland wird die pfluglose Bodenbearbeitung angewandt. In einem Dauerfeldversuch werden die langfristigen Auswirkungen dieser nichtwendenden Bodenbearbeitung auf den Unkrautauflauf untersucht. Seit dem Herbst 2007 werden dazu die Wirkungen von zwei unterschiedlichen Bodenbearbeitungsvarianten, neben anderen Faktoren, auf den Auflauf von Windhalm (*Apera spica-venti*) in einem Langzeitversuch untersucht. Die Versuchsfelder sind in Brandenburg, ca. 50 km entfernt von Berlin, beheimatet.

Die Fruchtfolge des Versuchs besteht aus Winterraps, Winterweizen, Wintergerste, Wintertriticale, Erbsen und Mais. Die hier betrachteten Versuchspartellen wurden seit Versuchsbeginn 1995 mit Herbiziden behandelt. Der Unkrautauflauf, die Anzahl und Art, wurde vor der Herbizidbehandlung (im Herbst oder Frühjahr) in jeder Versuchspartelle an 4 Punkten mit jeweils 0,25 m² gezählt.

Die Ergebnisse zeigen, dass die Anzahl der Windhalmpflanzen im Median bei den Getreideversuchspartellen in den gepflügten Varianten zwischen 9 (2013) und 55 (2010) Pflanzen/m² lag. In den pfluglosen Versuchspartellen lag der Median zwischen 18 (2009) und 140 (2017) Windhalmpflanzen je m². In den pfluglosen Versuchspartellen steigt die Anzahl der keimenden *Apera spica-venti* Pflanzen seit 2007 an.

Stichwörter: *Apera spica-venti*, Bodenbearbeitung, Dauerfeldversuch, Windhalm

Introduction

Minimum tillage, i.e. mainly without plowing the soil, is practiced on about 40% of the arable fields in Germany (STATISTISCHES BUNDESAMT, 2011). There are some advantages of minimum tillage like the reduction of energy consumption (SCHWARZ, 2013) and with that a lower production of greenhouse gases. The risk of soil erosion is also reduced.

As always in life there are some disadvantages. Problems with animals, mice and slugs can be observed. As a main disadvantage the increase of monocotyledonous weeds is usually described (AMANN, 1991; DITTMANN, 2012). In order to answer the question whether there is an upper limit on the number of the monocotyledonous weeds, this was investigated in a long-term field trial.

Materials and Methods

The experimental fields of the Julius Kühn-Institute are located in Dahnsdorf. The experimental site is situated in southern Brandenburg (52.108494 N, 12.636338 E), so called "Hoher Fläming", near the town of Bad Belzig. The soil is a loamy sand soil with 57.9% sand, 37.5% silt and 4.6% clay; the pH is 5.8. The average annual temperature and mean annual precipitation (weather station on the field) is 9.4 °C and 597 mm (1997 – 2016); with prolonged dry periods at early summer.

The long-term field trial started in the year 1995, since autumn 2007 two different soil cultivation methods are investigated. One cultivation method is done with a plough (inversion tillage), the other with a field cultivator (non-inversion tillage).

Only the plots that were treated with herbicides since start of the field trial in 1995 are investigated for this paper. For this calculation, no distinction between the two different crop rotations (till 2007) and the two different plant protection strategies was made. The herbicide treatment for the two soil cultivation methods was the same, except for the use of Glyphosate on stubble in some years and for some crops only in plots with non-inversion tillage.

Before herbicide treatment took place, the weeds were recorded for each plot at 4 different points with an area of 0.25 m² each. Both weed number and species were determined..

To receive better results, the values for all cereals were combined. With this averaging calculation, the number of plots is increased and the reliability of the results is improved.

Results

The results for the emergence of *Apera spica-venti* are shown in Figure 1 and 2. Figure 1 shows the results for the plots with inversion tillage and Figure 2 the results with non-inversion tillage. The results are shown as box plots with the upper and lower quartiles, the mean and the median. In order to be able to compare the *Apera spica-venti* values of the different soil cultivations, the axis values were adjusted for both figures.

As shown in Figure 1, since 2011 the emergence of *Apera spica-venti* ranged between a median of 9 and 24. The upper quartiles, i.e. 75% of the values, are not above 40 plants/m². The maximum value was 189 plants/m² *Apera spica-venti*.

For the plots with non-inversion tillage (Fig. 2), there are higher values for the emergence of *Apera spica-venti*. Since 2011, the median for each year was higher than for the plough plots. Moreover, the range of *Apera spica-venti* plant numbers was distinctly wider. For 4 years, the upper quartile extended the number of 100 *Apera spica-venti* plants/m². The maximum value was 1029 plants/m².

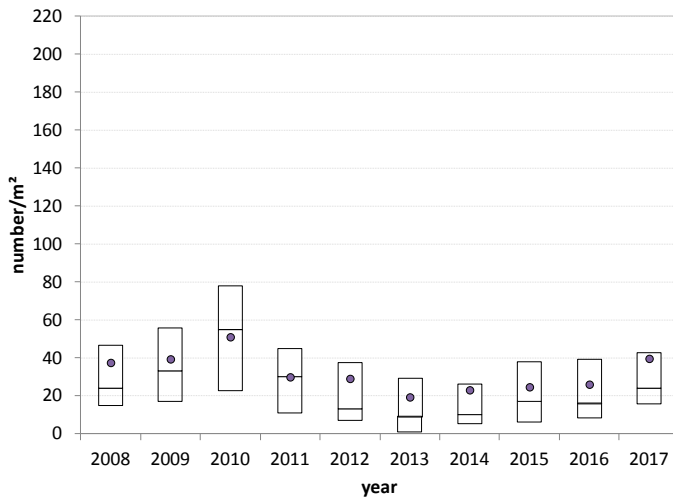


Fig. 1 Emergence of *Apera spica-venti* (number/m²) in the plots with inversion tillage, shown as box-plots with the upper and lower quartiles with the dot being the mean.

Fig. 1 Auflauf von Windhalm (Anzahl/m²) in den Parzellen mit Pflug, dargestellt als Box-Plots mit unterem und oberem Quartil, der Punkt zeigt den Mittelwert.

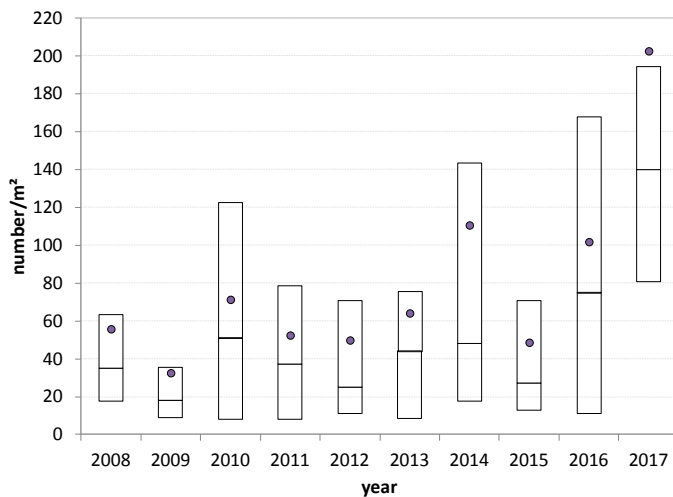


Fig. 2 Emergence of *Apera spica-venti* (number/m²) in the plots with non-inversion tillage, shown as box-plots with the upper and lower quartiles with the dot being the mean.

Fig. 2 Auflauf von Windhalm (Anzahl/m²) in den Parzellen ohne Pflug, dargestellt als Box-Plots mit unterem und oberem Quartil, der Punkt zeigt den Mittelwert.

Discussion

The widespread use of non-inversion tillage in Germany raises questions about the long-term effects on the development of weeds. In the case of *Apera spica-venti*, the weather and, in particular, the resulting soil moisture plays an important role because it emerges from a small depth. For the long-term field trial in Dahnsdorf the results showed that after 3 to 4 years of

minimum tillage, the numbers of *Apera spica-venti* increased constantly. Since 2011, in the plough plots the values for the upper quartile did not exceed 45 *Apera spica-venti* plant/m².

In the plots with non-inversion tillage, the effect of the soil conditions and the weather could have more influence on the germination of *Apera spica-venti*. This is especially true for the year 2017 with a mean of 202 *Apera spica-venti* plants/m². Locations with lighter soils and higher rainfall favored *Apera spica-venti* (MELANDER et al., 2008).

Despite that, there are also years like 2015, with a nearly comparable emergence of *Apera spica-venti* in both soil cultivation methods. One reason could be the higher mean temperature in October 2014. The average temperature in this month was 12.0 °C, which was notably higher than the average temperature in the following years (October 2015: 7.6 °C, October 2016: 8.4 °C). According to PIEPER (1912) *Apera spica-venti* germinates only near the soil surface. In warmer and dryer years, like autumn 2014, the soil may not contain sufficient moisture for the emergence of *Apera spica-venti*.

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